Optimal Design of Lattice Structure Considering Constraints through Additive Manufacturing Process

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ABSTRACT

This study examines the flexural rigidity of three-dimensional metallic lattices (Fig.1) subjected to 3-point bending (Fig.2). The lattices were fabricated by Selective Laser Melting (SLM). In recent years, as a result of rapid developments in additive manufacturing technologies, it has become possible to fabricate a range of complex shapes, including periodic lattice structures. However, in real metallic lattice specimens, geometrical imperfections[1], such as excessive ovalization of the struts and geometrical constraints, i.e. the maximum angle between strands exist in every unit because of the stochastic influence of feasible processing path (Fig.3). Here, a new optimization approach that accounts for such conditions is presented, and the optimal shape is discussed. Further, the structure determined by the optimization (Fig.4) was formed (Fig.5), and a three-point bending test was performed.

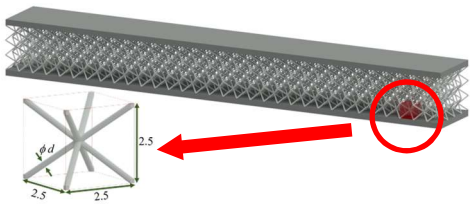

Fig.1 Three-dimensional metallic BCC lattices manufactured via SLM

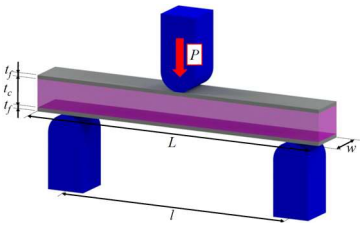

Fig.2 Schematic of 3-point bending test

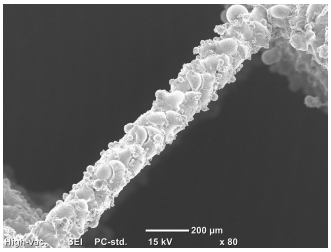

Fig.3 Photo of a specimen imaged by SEM

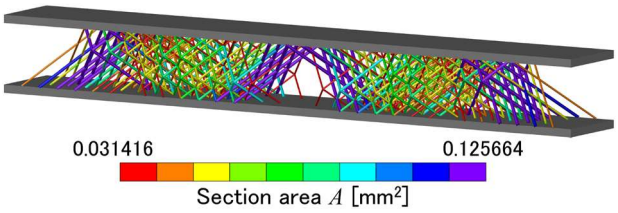

Fig.4 Layout of optimized BCC lattice structure

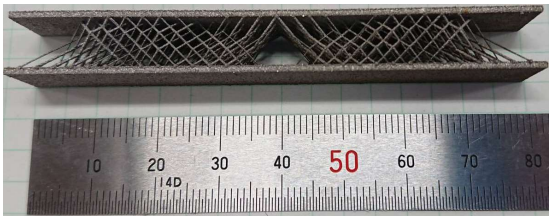

Fig.5 Photo of optimized sample fabricated by SLM machine

REFERENCES

[1] B. Lozanovski et al., Computational modelling of strut defects in SLM manufactured lattice structures, *Materials & Design*, Volume **171**, 5 (2019), 107671